

## **REMARKS**

Claims 1-2, 4-8, 10-35, and 40-45 are pending in this application. In the Office Action of January 4, 2006, claims 1, 7, 12, 23 and 44 were objected to because of various informalities. Claim 1 was amended to add a comma after "hydrocarbon" and change the transitional phrase "that includes" to "comprising". Claims 7 and 12 were amended to place the claims in proper Markush format. Claim 23 was amended to change "%w" to "wt%". Claim 44 was amended to change "further comprising" to "wherein". These amendments were made to remove informalities, not to address any issues directed to the merits of the patentability of the subject matter of the invention.

Claims 4-8, 10 and 11 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner submitted that claims 4-8, 10 and 11 improperly depend from a cancelled claim. Claim 4 was amended to correct the dependency of the claims. Applicants respectfully traverse this rejection based on the claims as currently amended.

Claims 1, 2, 4-8, 10-15, 17, 19-21, 25, 29, 30, 40-43 and 45 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Minet et al. (U.S. 5,229,102) in view of Mikus et al. (WO 99/18392). Applicants respectfully traverse this rejection based on the claims as currently amended. The MPEP § 2143 states:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Minet et al. teaches a steam-reforming reactor that employs a tubular ceramic membrane in a heated tube. The membrane allows the hydrogen to permeate out of the reaction zone as it is formed allowing the conversion of methane (and other hydrocarbons) to hydrogen to proceed to more than 90+%. The invention of Minet et al.

is directed to the use of a hydrogen permeable membrane to allow the steam reforming action to be effective at lower temperatures. Minet et al. teaches that the NO<sub>x</sub> emissions can be reduced (col. 3, lines 14-33) and that the temperature is controlled effectively through the use of a temperature sensor to measure the temperature in the reaction zone. (col. 4, lines 26-30). The invention of Minet et al. is not concerned with problems associated with exceeding the maximum allowable tube skin temperature or producing coke in the process tube because the system is operated at a low temperature in the range of from 300 to 700 °C.

Mikus et al. teaches a process heater employing flameless distributed combustion that is in heat exchange relationship with a process chamber. One embodiment of the invention of Mikus et al. involves a steam-reforming reactor where the process chamber contains the appropriate catalyst and the reaction is carried out in the process chamber. Conventional steam reformers require high temperatures to carry out the steam reforming reaction. The reaction products from a conventional steam reformer are then cooled and undergo a water-shift reaction in a separate reactor. Then, the reaction products go to either a pressure swing adsorption unit, a membrane separation unit or some other means of separating the hydrogen from the reaction product stream, as described in attached Exhibit 1 (US Patent Application Publication 2005/0201929). The high temperature is required in the conventional steam reformer to achieve satisfactory conversion and production of hydrogen. The separation of the hydrogen from the other reaction products occurs downstream from the steam-reforming reactor after the product stream has been cooled and passed through the additional reactors. The invention of Mikus et al. is directed to replacing direct-fired burners with a flameless combustion apparatus to allow high temperatures to be reached inside the process tube used to heat the feed to the steam reforming reactor without producing hot spots or exceeding the maximum allowable tube skin temperature in localized sections of the tube.

There is no suggestion to combine the teachings of Mikus et al. with the teachings of Minet et al. Mikus et al. teaches a flameless combustion heating system that heats the feed to a steam reformer to very high temperatures to provide for the desired products. Minet et al., on the other hand teaches a reactor that can be employed to carry out a low temperature steam reforming reaction that results in the desired products. It would not be

obvious to one of ordinary skill in the art to combine an invention directed to maximizing the temperature of the process fluid with an invention directed to carrying out a process at lower temperatures.

Even if the prior art were combined as proposed, the resultant combination would still fall short of yielding the claimed invention. Minet et al. teaches the use of a reactor that employs a tubular membrane enclosed within a heated metallic tube. Minet et al. teaches that the heat is provided by the combustion of fuel gas in the enclosing furnace and Fig. 2 depicts an embodiment comprising several banks of reactors in a furnace. Mikus et al. does not teach the use of two concentric tubes with a plurality of fuel tubes. The embodiments, depicted in Fig. 3 & 9, show a plurality of fuel tubes, but not in combination with one process chamber that is concentric with one oxidation chamber as claimed in the present application. A combination of the teachings from these two patents would not result in an apparatus for steam reforming as claimed in the present application. Since claim 1 is novel and not obvious, the claims that depend from claim 1 (claims 2, 4-8, 10-15, 17, 19-21, 25, 29, 30, 40-43 and 45) are also novel and not obvious.

Claims 16, 18, 22 and 25-28 were rejected under 35 U.S.C. §103(a) as being unpatentable over Minet et al. in view of Mikus et al., as applied to claim 1, 12 and 13, and further in view of Lin et al. (EP 1 024 111). Applicants respectfully traverse this rejection. Claims 16, 18, 22 and 25-28 are dependent on claim 1, and are not obvious for the reasons discussed with respect to claim 1 above.

Claim 23 was rejected under 35 U.S.C. §103(a) as being unpatentable over Minet et al. in view of Mikus et al. and Lin et al., as applied to claims 1, 12 and 22, and further in view of Juda et al. (US 5,904,754) or Rosset (US 2,958,391) or Behr et al. (US 4,496,373). Applicants respectfully traverse this rejection. Claim 23 is dependent on claim 1, and is not obvious for the reasons discussed with respect to claim 1 above.

Claim 24 was rejected under 35 U.S.C. §103(a) as being unpatentable over Minet et al. in view of Mikus et al. as applied to claims 1 and 12, and further in view of Rosset. Applicants respectfully traverse this rejection. Claim 24 is dependent on claim 1, and is not obvious for the reasons discussed with respect to claim 1 above.

Claims 31-35 were rejected under 35 U.S.C. §103(a) as being unpatentable over Minet et al. in view of Mikus et al as applied to claim 1, and further in view of Topsoe

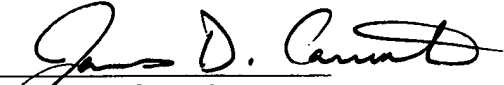
(US 5,169,717). Applicants respectfully traverse this rejection. Claims 31-35 are dependent on claim 1, and are not obvious for the reasons discussed with respect to claim 1 above.

Claim 44 was rejected under 35 U.S.C. §103(a) as being unpatentable over Minet et al. in view of Mikus et al. as applied to claim 1 above, and further in view of Edlund (US 5,861,137). Applicants respectfully traverse this rejection. Claim 44 is dependent on claim 1, and is not obvious for the reasons discussed with respect to claim 1 above.

In light of the above, Applicants respectfully request allowance of the pending claims in the application.

Respectfully Submitted,

WELLINGTON, Scott Lee et al.

By their attorney:   
James D. Carruth  
Reg. No. 55,038  
Shell Oil Company  
(713) 241-0135